Attorney Docket No. 2000.16 *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:
Runkle et al.

Group Art Unit: 1732

Serial No. 09/851,242

Examiner: S. Staicovici

Filed: May 8, 2001

For: METHOD FOR MAKING A HOLLOW FIBER MEMBRANE CONTACTOR

VIA FACSIMILE
571-273-8300
Total Pages: 58

REPLY BRIEF 37 CFR § 1.191 §41.41

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Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This Reply Brief is filed in response to the Examiner's Answer mailed March 17, 2006. It relates to the Appeal Brief as filed, January 5, 2006, in reply to the Office Action mailed July 28, 2005.

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office on May 15, 2006.

Junice B. Davis

Table of Contents

I. REAL PARTY IN INTEREST

The real party in interest is Celgard Inc., the assignee of record in the instant application.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences. Applicants note that this is the same case that was the subject of Appeal No. 2004-2240 which was remanded to the Examiner. See Related Proceedings Appendix on page 13.

III. STATUS OF THE CLAIMS

A. Claims 1, 16, and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by JP 11-169676.

B. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 5,186,832 ("*Mancusi*").

C. Claims 17-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 4,961,760 ("*Caskey*").

D. Claims 4-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 4,800,019 ("*Bikson*").

E. Claims 21, 24 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of Applicant's Admitted Prior Art.

F. Claims 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of *Bikson*.

G. Claims 25 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of *Caskey*.

H. Claims 1-2, 4-5, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of *Bikson*.

I. Claims 1-2, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676.

J. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of *Bikson*.

K. Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of *Bikson* in further view of *Caskey*.

L. Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of *Caskey*.

M. Claims 21 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of Applicant's Admitted Prior Art.

N. Claims 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of Applicant's Prior Art and *Bikson*.

O. Claims 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of Applicant's Prior Art and *Caskey*.

P. Claims 1-2, 4-5, 16, and 18-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,284,584 ("*Huang*") in view of *Mancusi* and in further view of *Bikson*.

Q. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Huang* in view of *Mancusi* and in further view of *Bikson* and *Caskey*.

R. Claims 21-24 and 26-27 rejected under 35 U.S.C. 103(a) as being unpatentable over *Huang* in view of *Mancusi* and in further view of *Bikson* and Applicant's Admitted Prior Art.

S. Claims 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Huang* in view of *Mancusi* and in further view of *Bikson*, Applicant's Admitted Prior Art, and *Caskey*.

Claims 1-2, 4-5, 16-19, and 21-27 are the subject of this appeal. Claims 3, 20, and 28 are canceled. Claims 6-15 are withdrawn from consideration in view of a restriction requirement.

IV. STATUS OF AMENDMENTS

No Amendment was made after the final rejection based on the new grounds for rejection.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The following is a concise explanation of the subject matter defined in independent Claims 1 and 21.

The instant invention, according to Claim 1, is a method of making a hollow fiber membrane contactor. (Specification, Page 4, Lines 12-13). The method of making a hollow fiber membrane contactor, according to Claim 1, includes the following steps: (1) winding a hollow fiber fabric around a center tube; (2) first potting the fabric and the tube together; (3) forming thereby a unitized structure; (4) placing the structure into a shell; (5) second mold potting the structure into a space between the structure and the shell; and (6) forming thereby a cartridge. (Specification; Page 7, line 16 to Page 18, Line 25).

The instant invention, according to Claim 21, is a method of making a hollow fiber membrane contactor. (Specification, Page 4, Lines 12-13). The method of making a hollow fiber membrane contactor, according to Claim 21, includes the following steps: (1) winding a hollow fiber fabric around a center tube to a diameter of at least six inches; (2) bead potting the fabric and the tube together; (3) forming thereby a unitized structure; (4) placing the structure into a shell; (5) mold potting the structure and the

shell together by injecting a potting material into a space between the structure and the shell; and (6) forming thereby a cartridge. (Specification; Page 7, line 16 to Page 8, Line 25; and Page 9, lines 8-11).

VI. GROUND'S OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 16, and 19 are rejected under 35 U.S.C. 102(b).

Claims 1-2, 4-5, 16-19, and 21-27 are rejected under 35 U.S.C. 103(a).

Claims 1-2, 4-5, 16-19, and 21-27 are the subject of this appeal.

VII. ARGUMENT

Applicants note that in the Examiner's Answer the Examiner has acknowledged that: the (3) STATUS OF THE CLAIMS, (4) STATUS OF AMENDMENTS, (5) SUMMARY OF THE CLAIMED SUBJECT MATTER, (6) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL, (7) CLAIMS APPENDIX, are all correct. Further it is noted that Applicants provided a statement identifying (1) REAL PARTY IN INTEREST, (2) RELATED APPEALS AND INTERFERENCES.

Applicants note that there is no controversy on what the stated grounds of rejection are, the only issue in controversy is the Examiner's rejection of Claims 1, 16, and 19 under 35 U.S.C. 102(b) as being anticipated by JP 11-169676, rejection of claim 2 under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), the rejection of claims 17-18 under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 4,961,760 ("*Caskey*"), the rejection of claims 4-5 under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of U.S. Patent No. 4,800,019 ("*Bikson*"), the rejection of claims 21, 24 and 27 under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of Applicant's Admitted Prior Art, the rejection of claims 22 and 23 under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of *Bikson*, the rejection of claims 25 and 26 under 35 U.S.C. 103(a) as being unpatentable over JP 11,169676 in view of in view of Applicant's Admitted Prior Art in further view of *Caskey*, the rejection of claims 1-2, 4-5, and 19 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of *Bikson*, the rejection of claims 1-2, and 19 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676, the rejection of claims 4 and 5 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view

of JP 11,169676 and in further view of *Bikson*, the rejection of claims 16-18 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of *Bikson* in further view of *Caskey*, the rejection of claims 16-18 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of *Caskey*, the rejection of claims 21 and 27 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of Applicant's Admitted Prior Art, the rejection of claims 22-23 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of Applicant's Prior Art and *Bikson*, the rejection of claims 24-26 under 35 U.S.C. 103(a) as being unpatentable over *Mancusi* in view of JP 11,169676 and in further view of Applicant's Prior Art and *Caskey*, the rejection of claims 1-2, 4-5, 16, and 18-19 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,284,584 ("*Huang*") in view of *Mancusi* and in further view of *Bikson*, the rejection of claim 17 under 35 U.S.C. 103(a) as being unpatentable over *Huang* in view of *Mancusi* and in further view of *Bikson* and *Caskey*, the rejection of claims 21-24 and 26-27 under 35 U.S.C. 103(a) as being unpatentable over *Huang* in view of *Mancusi* and in further view of *Bikson* and Applicant's Admitted Prior Art, the rejection of claims 25 is under 35 U.S.C. 103(a) as being unpatentable over *Huang* in view of *Mancusi* and in further view of *Bikson*, Applicant's Admitted Prior Art, and *Caskey*, is correct.

In the instant application claims 1 and 21 are independent method claims. These claims are unique because they teach a process of forming a hollow fiber membrane contactor utilizing two different potting steps. Specifically the hollow fiber fabric is wrapped around a center tube and the fabric and tube are potted together to form a unitized structure, first potting step. Then the unitized structure is placed into a shell and the shell and the unitized structure are potted to form a cartridge, second potting step.

This process is not difficult, but it is unique in that it is not taught or anticipated by the prior art. Further, it solves the problem of potting shrinkage, which heretofore has gone unaddressed.

Claim rejections under 35 USC § 102(b)

The Examiner has rejected claim 1 as being anticipated by JP 11-169676 under 35 USC § 102(b). As stated in Applicant's appeal brief the black letter law is that to anticipate a claim a single source must anticipate all the elements of that claim.

Now if one, of ordinary skill in the art, looks at claim one it starts out by reciting the steps of "winding a hollow fiber

fabric around a center tube". Looking at JP 11-169676 this reference fails to disclose a "hollow fiber fabric" and fails to disclose a "tube". Therefore the first step cannot be anticipated by the cited reference, as both the key elements of a "hollow fiber fabric" and a "tube" are missing.

If one actually reads the cited reference, the English language translation is attached in the evidence appendix starting at page 27, one sees that this reference teaches the use of hollow fiber membrane bundles which comprise a bundle of 50 to 200 hollow fiber membranes. The hollow fiber fabric shown in Applicant's Figure 2 looks nothing like "4 Hollow fiber fabric bundle" of the prior art which is subsequently wound around itself, an not a core or tube, as set forth in paragraph 27, to form a rolled hollow fiber membrane bundle aggregate 13. This alone clear precludes this as a reference under 35 USC § 102(b).

JP 11-169676 goes on to teach that after the rolled hollow fiber membrane bundle aggregate 13 is inserted in the container 1, the molds 14, 15 are installed on both ends and the rolled hollow fiber membrane bundle aggregate 13, and are then potted. This is done once. This potting uses the rolled hollow fiber membrane bundle aggregate 13 taught by JP 11-169676, it does not include the tube or hollow fiber fabric of the instant invention.

Clearly cited reference JP 11-169676 fails to disclose a "tube" around which a "hollow fiber fabric" is wound. The reference JP 11-169676 only teaches a single potting and not two potting steps, therefore the rejection based on 35 USC § 102(b) is improper. The claims must be allowed.

Claims 16 and 19 are equally allowable with claim 1.

The Examiner has made numerous rejections to the dependent claims 2, 17-18, 4-5, based on the assumption that underlying rejection to independent claim 1 from reference JP 11-169676 under 35 USC § 102(b) is proper. If claim 1 is not anticipated by this reference, no combination of this reference and any other reference under 35 USC § 103(a) is proper, and must be removed.

With respect to the rejection of claim 21 as being obvious from JP 11-169676 under 35 USC § 102(b) in view of Applicants' Admitted prior art, this too is incorrect and must be withdrawn. As set forth above, in the rebuttal of the rejections based on 35 USC § 102(b), the instant invention is not anticipated by this reference, therefore the addition of the feature that the hollow fiber fabric wound around a tube to a diameter of at least 6 inches is also distinct from this reference.

The Examiners rejections of dependent claims 24, 27, 22, 23, 25, 26 are allowable over the primary reference JP 11-169676 and any subsequent secondary references.

Claim rejections under 35 USC § 103(a)

The Examiner's rejection as set forth in sections H, K, L, P, Q, R, S, of the Examiner's Answer of March 17, 2006, were all rejection that where remanded to the Examiner by the Board in a decision mailed on January 27, 2005. The rejections in H, K, L, all rejected the claims using Mancusi as the primary reference relied on. The rejections in sections P, Q, R, S all rejected the claims using Huang as the primary reference and Mancusi as the secondary reference relied on. In the original appeal brief filed by Robert H. Hammer, III, on January 28, 2004, over two years ago, attached as an appendix was the declaration of Charles Runkle. Applicant's note that the board unequivocally stated that: "Secondary considerations of obviousness, such as the Runkle declaration, when entered into the record, must be considered by the examiner." In the Supplemental Examiner's Answer mailed on March 29, 2005, the Examiner made no reference to the Runkle Declaration. In the Examiner's Final rejection mailed on July 28, 2005, no mention was made to the Runkle declaration. In the Examiner's Answer mailed March 17, 2006, once again the Examiner

makes no mention of the Runkle declaration in blatant disregard of the Board of Patent Appeals and Inference's clear instruction.

With respect to the objections outlined in sections H, K, L, P, Q, R, S, of the Examiner's Answer of March 17, 2006, the Examiner set forth that the main reference is either Mancusi or Huang. In section H with regard to claim 1 the Examiner avers Mancusi teaches two potting steps. The Runkle declaration refutes this. In section P with regard to claim 1 the Examiner avers Mancusi teaches two potting steps. The Runkle declaration refutes this. In Section R with regard to claim 21 the Examiner avers Mancusi teaches two potting steps. The Runkle declaration refutes this.

Applicants note that the Runkle Declaration was made of record in Applicant's first Amendment of December 17, 2002. Applicant would like to point out to the Board that Charles J. Runkle was a named inventor in both the Mancusi et al reference, US patent 5,186,832 and the Huang et al reference, US patent 5,284,584. As a named inventor in the prior art references, Mr. Runkle is uniquely qualified to comment on what is disclosed in these references.

Applicants note that Secondary considerations of obviousness, such as the Runkle declaration, when entered into the record, must be considered by the examiner. See Richardson-Vicks Inc. v. Upjohn Co., 122 F.3d 1476, 1483, 44 USPQ2d 1181, 1186 (Fed. Cir. 1997); see also Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1538, 218 USPQ 871, 879 (Fed. Cir. 1983). However, on this record, the examiner has not specifically addressed in the answer to appellants' declaration (mentioned both in the brief and the reply brief as noted above; see the answer in its entirety). The answer should reflect that appellants' arguments and any entered evidence relied upon were weighed against the examiner's evidence of obviousness. See In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); In re Piasecki, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984); and In re Rinehart, 531 F.2d 1048, 1052, 189 USPQ 143, 147 (CCPA 1976).

Based on Applicants' arguments made in the original appeal of January 28, 2004, and the Appeal of January 5, 2006, along with the Declaration of Charles Runkle which was added into the record on December 17, 2002, Applicants respectfully request that the Board find that claims 1-2, 4-5, 16-19 and 21-27 are Patentable over Mancusi and Huang in view of Mancusi and allow these claims over the Examiner rejections in sections H, K, L, P, Q, R and S under 35 USC § 103(a).

With respect to the Examiners rejections made in section I, J, M, N, O of the Examiner's Answer of March 17, 2006, Applicants traverse. In these sections independent claims 1 and 21 stand rejected as being obvious from Mancusi in view of JP 11-169,676. In section I, with regard to claim 1, the Examiner avers Mancusi teaches two potting steps. The Runkle declaration refutes this. In section M, with regard to claim 21, the Examiner avers that prior art teaches everything but the size feature. The Runkle declaration refutes this.

Applicants assert that each and every independent claim (claims 1 and 21) is patentable over the Mancusi in view of JP 11-169,676. Therefore the dependent claims 2, 4-5, 16-19 and 22-27 should be equally allowable therewith.

QUESTION BEFORE THE BOARD

Even though this Reply Brief and the Examiner's answer are both lengthy the questions in this case are simple and straight forward.

First, if the Board reads independent claim 1 and looks at the cited reference attached in the appendix (Evidence appendix pages 27-44) it should be clear the JP 11-169,676 fails to teach or

suggest a hollow fiber fabric, a tub or a second potting step. Without these features the instant invention cannot be anticipated by JP 11-169,676. If the instant invention is not anticipated than the claim rejections set forth in the Examiner's answer to dependent claims 2, 4, 5, 16-19 and 22-27 and independent claim 21 should be equally allowable. This answers the Examiner's voluminous rejections in sections A-G.

Second, if pending claims 1-2, 4, 5, 16-19 and 22-27 are anticipated by Mancusi and Huang in light of the declaration of M. Runkle entered into the record on December 17, 2002. Here it should be pointed out that on Pages 5 and 6 of this Board's REMAND TO THE EXAMINER mailed on January 27, 2005, (Evidence Appendix pages 53-54) the board specifically pointed out to the Examiner that he had failed to mention this declaration or particularly address the Applicants' remarks concerning that declaration in the answer. Since the Mailing of the Board's Remand the Examiner has filed a Supplemental Examiner's Answer of March 8, 2005, a final ejection of July 28, 2005, and an Examiner's Answer of March 17, 2006, none of which address the Runkle Declaration (Evidence Appendix pages 45-47) that the Board requested the Examiner to address. Applicants believe that from Applicants' arguments made in the original appeal of January 28, 2004, and the Appeal of January 5, 2006, along with the Declaration of Charles Runkle which

was added into the record on December 17, 2002, that the rejection of all pending claims over Mancusi and Huang are improper (the Examiner's sections H-S) and must be overturned.

Evidence Appendix

Applicants note that the Declaration of Charles Runkle was made of record in this case as of December 17, 2002. This declaration should not be considered new matter. The Board's REMAND TO THE EXAMINER mailed January 17, 2005, is also of record, this REMAND should not be considered new matter.

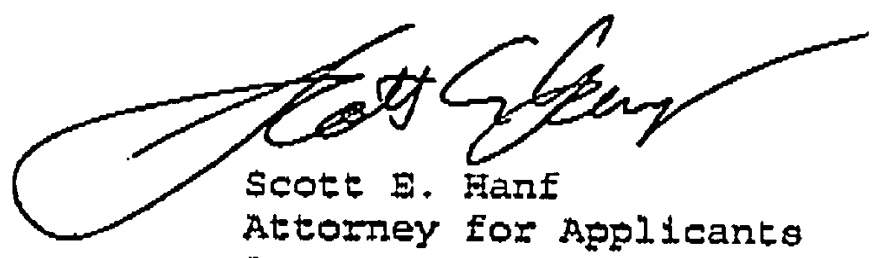
Conclusion

In view of the foregoing, Appellants respectfully request that the rejection be overturned and that the instant application be allowed to proceed to issuance.

Applicants respectfully request that since the first appeal was filed on January 28, 2004, and that the Examiner has already had three chances to address the Board's concerns, as set for in the REMAND TO THE EXAMINER of January 27, 2005, in the Examiner's Supplemental Examiner's Answer of March 8, 2005, a final ejection of July 28, 2005, and the Examiner's Answer of March 17, 2006, that

this Reply Brief and this Appeal be sent directly to the Board without further comment from the Examiner.

Respectfully submitted,



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SERIAL NO. 09/851,242
ART UNIT 1732

VIII CLAIMS APPENDIX

Listing of Claims:

1. (Previously Presented) A method of making a hollow fiber membrane contactor comprising the steps of:

winding a hollow fiber fabric around a center tube,

first potting the fabric and the tube together,

forming thereby a unitized structure,

placing the structure into a shell,

second mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and

forming thereby a cartridge.

2. (Original) The method of claim 1 wherein the first-mentioned potting being bead potting.

3. (Cancelled) ~~The method of claim 1 wherein the second-mentioned potting being mold potting~~.

4. (Original) The method of claim 1 further comprising the step of heat-treating the cartridge.

5. (Original) The method of claim 4 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

6. (Withdrawn) A hollow fiber membrane contactor comprising:

a unitized structure comprising

a center tube,

a hollow fiber fabric wound around said tube, and

a first potting material joining together said fabric and said tube;

a shell; and

a second potting material joining together said structure and said shell.

7. (Withdrawn) The contactor of claim 6 wherein said structure having a diameter of six (6) inches or more.

8. (Withdrawn) The contactor of claim 6 further comprising end caps located at end portions of said shell.

9. (Withdrawn) The contactor of claim 6 wherein the first potting material and the second potting material are the same.

10. (Withdrawn) The contactor of claim 6 wherein the potting material is selected from the group consisting of thermosetting materials and thermoplastic materials.

11. (Withdrawn) The contactor of claim 10 wherein the thermosetting materials are selected from the group consisting of epoxy and polyurethane.

12. (Withdrawn) The contactor of claim 10 wherein the thermoplastic materials are selected from the group consisting of polyolefins and polyurethanes.

13. (Withdrawn) The contactor of claim 5 further comprising a fabric spacer, said spacer adapted for maintaining said fiber of said fabric in a uniform and spaced apart fashion.

14. (Withdrawn) A system of contactors for degassing a liquid comprising at least two contactors coupled together, one said contactor being the contactor of claim 6.

15. (Withdrawn) The system of claim 14 wherein said structure having a diameter of 6 inches or greater.

16. (Previously Presented) The method of claim 1 wherein potting further comprises the first or the second potting with a material selected from the group consisting of thermosetting materials and thermoplastic materials.

17. (Previously Presented) The method of claim 16 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

18. (Previously Presented) The method of claim 16 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

19. (Previously Presented) The method of claim 1 wherein placing the structure into a shell further comprises centering the structure in the shell.

20. (Canceled) ~~The method of claim 1 wherein potting the structure and the shell together further comprises injecting a potting material into a space between the structure and the shell.~~

21. (Previously Presented) A method of making a hollow fiber membrane contactor comprising the steps of:

winding a hollow fiber fabric around a center tube to a diameter of at least six inches,

bead potting the fabric and the tube together,

forming thereby a unitized structure,

placing the structure into a shell,

mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and

forming thereby a cartridge.

22. (Previously Presented) The method of claim 21 further comprising the step of heat-treating the cartridge.

23. (Previously Presented) The method of claim 22 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

24. (Previously Presented) The method of claim 21 wherein bead or mold potting further comprises using a material selected from the group consisting of thermosetting materials and thermoplastic materials.

25. (Previously Presented) The method of claim 24 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

26. (Previously Presented) The method of claim 24 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

27. (Previously Presented) The method of claim 21 wherein placing the structure into a shell further comprises centering the structure in the shell.

IX Evidence Appendix

1. English Translation from Kokai Patent Application, H11-169676

TRANSLATION FROM JAPANESE

(19) Japan Patent Office

(12) Kokai Tokkyo Koho (A): Official Gazette for Kokai Patent Applications

(11) Japanese Patent Application Kokai Publication No.: **H11-169676**

(43) Kokai Publication Date: 29 June 1999

(51) Int. Cl.[6]	Identification No.:	FI
B 01 D 63/04		B 01 D 63/04
63/00	500	63/00 500
65/00		65/00

Examination request: Not requested

Number of claims: 9 OL (7 pages)

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(22) Application Filing Date: 10 December 1997

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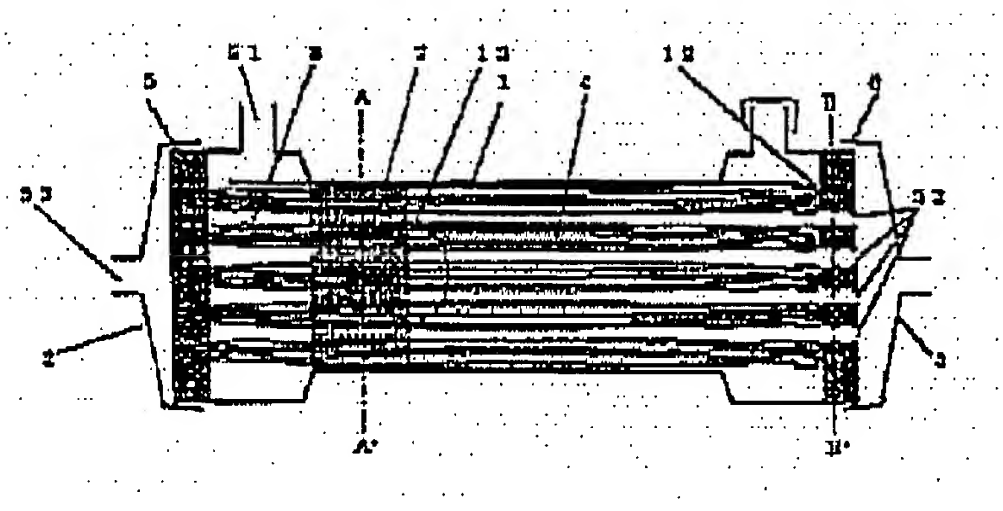
(54) [Title of the Invention]

Hollow fiber membrane module and a manufacturing method thereof

(57) [Abstract]

[Object] To provide a hollow fiber membrane module and a method of manufacture thereof, [such that the hollow fiber membrane module has] superior stability over long-term continuous operation and can be cleaned, and a structure wherein a uniform axial flow is produced without channeling, and without filling the container with the hollow fiber membrane at a high filling rate, for water treatment requiring a high rate of recovery.

[Means for Resolving] A hollow fiber membrane module having a structure wherein a hollow fiber membrane bundle group, near the port communicating with the outer surface of the hollow fiber membrane established on the side of the container in one module container, comprises a space communicating with the outside of the cross section perpendicular to the axis and the center of the hollow fiber membrane bundle group; and in which there are partitions for dividing the channel in the cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundles; and in which a plurality of divisions is provided to a port communicating with the outer surface of the hollow fiber membrane disposed on the resin-fixed end of the hollow fiber membrane.



[Claims]

[Claim 1] A hollow fiber membrane module wherein a hollow fiber membrane bundle group is installed in a container, one or both ends are fixed with resin, and [the module] comprising at least

one port A communicating with the inlet of the hollow fiber membrane, at least one port B communicating with the outer surface of the hollow fiber membrane disposed on the side of the container, and at least one port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane; wherein [the] hollow fiber membrane module comprises a partition forming a plurality of divisions in the channel in the hollow fiber membrane in a cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundle group, and wherein the hollow fiber membrane bundle group installed in the container in the vicinity of at least one port B has a plurality of divisions, and space is distributed between the divided hollow fiber membrane bundles.

[Claim 2] The hollow fiber membrane module, recited in Claim 1, wherein the port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane has a plurality of divisions and is disposed regularly.

[Claim 3] The hollow fiber membrane module, recited in Claim 1 or 2, wherein the filling rate of the hollow fiber membrane is 40% to 80%.

[Claim 4] The hollow fiber membrane module, recited in any of Claims 1 to 3, having a structure wherein the length of the hollow fiber membrane which is not bonded and fixed is at least 1.01 times the length of the distance between the bonded parts of both ends and can oscillate.

[Claim 5] The hollow fiber membrane module, recited in Claim 1, wherein the arrangement of the hollow fiber membrane bundles is in the form of a spiral in the cross-sectional direction of the hollow fiber membrane bundle group.

[Claim 6] The hollow fiber membrane module, recited in Claim 2, wherein the plurality of ports C, communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane, is arranged in a spiral.

[Claim 7] A method for manufacturing a hollow fiber membrane module wherein a hollow fiber membrane bundle group is installed in a container, one or both ends are fixed with resin, and [the module] comprising at least one port A communicating with the inlet of the hollow fiber membrane, at least one port B communicating with the outer surface of the hollow fiber membrane disposed on the side of the container, and at least one port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane;

wherein the method for manufacturing the hollow fiber membrane module comprises:

bundling hollow fiber membranes to form hollow fiber membrane bundles;

arranging and rolling into a cylinder the hollow fiber membrane bundles on a partition member for distributing the flow channels and a port distributing member for forming a plurality of ports in the resin-fixed end of the hollow fiber membrane, to form a hollow fiber membrane bundle group;

distributing space between the divided hollow fiber membrane bundles by fixing the ends of the hollow fiber membrane bundle group with resin and cutting the fixed ends;

forming regularly distributed axial channels; and

forming a plurality of regularly distributed ports C on one of the fixed ends and forming a hollow fiber membrane open end on the other end.

[Claim 8] The method for manufacturing a hollow fiber membrane module, recited in Claim 7, wherein the arrangement of the hollow fiber membrane bundles is in the form of a spiral in the cross-sectional direction of the hollow fiber membrane bundle group.

[Claim 9] The method for manufacturing a hollow fiber membrane module, recited in Claim 7, wherein the plurality of ports C, communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane, is arranged in a spiral.

[Detailed Description of the Invention]

[0001]

[Technical field of the Invention]

The present invention relates to a hollow fiber membrane module and a manufacturing method thereof used in water purification treatment of natural water such as river water, ground water, or the like, or in advanced water purification treatment for tap water. The hollow fiber membrane module attained with the present invention can be used in the field of water treatment, which requires long-term continuous operation at high rates of recovery and the restoration of module performance by physical cleaning or the like.

[0002]

[Prior Art]

Recently, in the field of water purification treatment of natural water such as river water, ground water, or the like, purification methods applying membrane separation technology have become noteworthy as methods for replacing coagulation-sedimentation. Modules using hollow fiber membranes are widely employed for water purification because [such modules] can be installed in containers, regardless of the form of the container, and can be physically cleaned with ease.

[0003]

Modules employed in water purification must have a module design with a high rate of recovery (rate of recovery = discharge ratio of permeate to feed water) in order for maximal recovery of feed water and for effective utilization. Also, in order for operation at a high rate of recovery, the upstream side of the membrane in the module is highly concentrated; moreover, in the case of a reverse osmosis membrane or nano-filtration membrane, the flow rate at the upstream side of the membrane in the module is very low and the linear velocity on the membrane surface becomes very low. Generally, in this situation, uniform distribution of the feed, without causing channeling and across the entire hollow fiber membrane surface, is difficult in the case of an external pressure-type module. When channeling occurs in the module, the membrane cannot be used effectively and the separation efficiency drops markedly. Also, when a highly concentrated liquid flows at very low speeds to the upstream side of the membrane in the module, foulant adheres and settles on the membrane's surface, the membrane surface contributing to separation becomes coated and deteriorates, and the separation capacity drops markedly. For this reason, a module design which eliminates both channeling and fouling is necessary for water purification treatment requiring a high rate of recovery.

[0004]

However, for conventional modules, a module design is used in which the hollow fiber membrane is given a uniform distribution and a uniformly distributed flow is developed within the module, by bundling the hollow fiber membrane at an extremely high filling rate in order to suppress channeling. Also used is a module design in which uniformly distributed flow is caused by creating a resistive element by fixing one end of [the hollow fiber membrane] to the container with resin and forming the other end of the hollow fiber membrane in a loop.

[0005]

In JP-S52-49987, JP-S52-63179, JP-S54-5796, and JP-S63-1404 are disclosed hollow fiber membrane modules having a module structure which is provided an axial flow, in which the hollow fiber membrane is rolled in a crisscross arrangement to form hollow fiber membrane bundles in order to suppress channeling, a tube is established in the hollow fiber membrane bundle, and flow to the central portion in a cross sectional direction of the hollow fiber membrane bundle is generated.

[0006]

Also, in JP-S61-103503 and JP-H9-206563 are disclosed hollow fiber membrane modules wherein a plurality of hollow fiber membrane bundles are arranged within the container to form a hollow fiber membrane bundle group, with both ends fixed with resin.

[0007]

Also, in JP-H9-187628 and JP-H9-220446 are disclosed hollow fiber membrane modules, wherein through holes are formed in the resin end portions fixing the hollow fiber membrane bundles, in order to supply raw water to the central portion in a cross-sectional direction perpendicular to the hollow fiber membrane bundles. Also, in JP-H9-187628 and JP-H9-220446 are disclosed module manufacturing methods, as methods for manufacturing through holes in the resin end portions wherein a tube-shaped item or through hole mold is installed in advance and removed following the bonding of the ends of the hollow fiber bundles.

[0008]

[Problems to be Solved by the Invention]

However, in a module in which the hollow fiber membrane is bundled at an extremely high filling rate, the hollow fiber membrane is easily damaged when the hollow fiber membrane bundles are inserted in the container and it becomes very difficult to manufacture the modules. Also, because of the low [amount of] space, the radial resistance to flow in the cross section of the hollow fiber membrane bundles becomes very high as module size increases and the treated water does not have a uniform radial distribution. As a result, channeling is promoted, the membrane is not effectively used, and separation efficiency becomes poor. Furthermore, in water purification requiring a high rate of recovery, the surface of the hollow fiber membrane as well as the gaps in the hollow fiber membrane are easily fouled because the upstream side of the membrane is highly concentrated, the transmission rate decreases, and long-term continuous operation becomes difficult. Also, in the case of physical cleaning of the foulant, the high filling rate of the hollow fiber membrane oppositely becomes a hindrance to cleaning and reduces cleaning efficiency.

[0009]

In a module in which a uniformly distributed flow is caused by creating a resistive element by fixing one end of [the hollow fiber membrane] to the container with resin and forming the other end of the hollow fiber membrane in a loop, fouling occurs easily because of the concentrate which is highly concentrated at the looped part of the hollow fiber membrane end. Furthermore, in the case of physically cleaning the foulant, the form of the hollow fiber membrane bundle group having loops

at one end is easily damaged and cannot be recreated. Also, a uniformly distributed flow is difficult to create in all channels from the feed portion to the concentrate outlet, in a module which is provided an axial flow, and in which the hollow fiber membrane is rolled in a crisscross arrangement in order to suppress channeling, a tube-shaped item is established in the hollow fiber membrane bundle, and there is flow to the central portion in a cross sectional direction of the hollow fiber membrane bundle. Fouling occurs easily due to the highly concentrated concentrate resulting from the presence of intersections of the hollow fiber membranes in the direction of the flow. As a result, the transmission rate drops and long-term continuous operation becomes difficult. Furthermore, in the case of physically cleaning the foulant, the hollow fiber membrane, rolled in a crisscross arrangement, hinders foulant cleaning and discharge, and reduces the cleaning efficiency.
[0010]

In a hollow fiber membrane module wherein a plurality of hollow fiber membrane bundles are arranged within the container to form a hollow fiber membrane bundle group, having both ends attached with resin, foulant easily accumulates in hollow fiber membrane gaps in the hollow fiber membrane bundles, the transmission rate drops, and long-term continuous operation becomes difficult. Also, foulant removal becomes difficult in the case of physically cleaning the foulant. In a hollow fiber membrane module having a structure in which through holes are formed in the resin ends fixing the hollow fiber membrane bundles and feed water is supplied to the center portion in a cross-sectional direction perpendicular to the hollow fiber membrane bundles, the feed water is uniformly distributed in the vicinity of the plurality of ports formed in the resin ends, but uniform distribution becomes difficult in the downstream part in an axial direction of the hollow fiber membrane bundles and in the vicinity of the outlet port. Furthermore, in the manufacturing method for establishing the through holes in the resin ends, a tube-shaped item or through hole mold is inserted in the hollow fiber membrane bundles for forming the through holes, before fixing the hollow fiber membrane bundles with resin; and the tube-shaped item or through hole mold for forming through holes is removed after the bonding and fixing of the hollow fiber membrane bundles. For this reason, the hollow fiber membrane is very likely to be bent and damaged. In the case where the diameter and the gaps between the through holes are narrow (on the order of several millimeters, for example), the operation for inserting and removing the tube-shaped item or through hole mold in the hollow fiber membrane bundles is very difficult.
[0011]

In water purification treatment requiring a high rate of recovery, the countermeasures for channeling and fouling have mutually exclusive elements and it is very difficult to resolve both issues at the same time.

[0012]

The present invention was made to resolve the problems described above, and provides a hollow fiber membrane module and manufacturing method thereof, without filling the hollow fiber membrane to an extremely high filling rate, wherein the hollow fiber membrane can be inserted in a container without being damaged, and [the module] has a uniformly distributed flow without channeling even during operation at a high rate of recovery and allows for physical cleaning with superior expulsion of foulant during cleaning.

[0013]

[Means for Solving the Problems]

The present invention is described below.

(1) A hollow fiber membrane module wherein a hollow fiber membrane bundle group is installed in a container, one or both ends are fixed with resin, and [the module] comprising at least one port A communicating with the inlet of the hollow fiber membrane, at least one port B communicating with the outer surface of the hollow fiber membrane disposed on the side of the container, and at least one port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane; wherein [the] hollow fiber membrane module comprises a partition forming a plurality of divisions in the channel in the hollow fiber membrane in a cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundle group, and wherein the hollow fiber membrane bundle group installed in the container in the vicinity of at least one port B has a plurality of divisions, and space is distributed between the divided hollow fiber membrane bundles.

(2) The hollow fiber membrane module, recited in (1), wherein the port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane has a plurality of divisions and is disposed regularly.

(3) The hollow fiber membrane module, recited in (1) or (2), wherein the filling rate of the hollow fiber membrane is 40% to 70%.

(4) The hollow fiber membrane module, recited in any of (1) to (3), having a structure wherein the length of the hollow fiber membrane which is not bonded and fixed is at least 1.01 times the length of the distance between the bonded parts of both ends and can oscillate.

(5) The hollow fiber membrane module, recited in (1), wherein the arrangement of the hollow fiber membrane bundles is in the form of a spiral in the cross-section direction of the hollow fiber membrane bundle group.

(6) The hollow fiber membrane module, recited in (2), wherein the plurality of ports C, communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane, is arranged in a spiral.

(7) A method for manufacturing a hollow fiber membrane module wherein a hollow fiber membrane bundle group is installed in a container, one or both ends are fixed with resin, and [the module] comprising at least one port A communicating with the inlet of the hollow fiber membrane, at least one port B communicating with the outer surface of the hollow fiber membrane disposed on the side of the container, and at least one port C communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane;

wherein the method for manufacturing the hollow fiber membrane module comprises:

bundling hollow fiber membranes to form hollow fiber membrane bundles;

arranging and rolling into a cylinder the hollow fiber membrane bundles on a partition member for distributing the flow channels and a port distributing member for forming a plurality of ports in the resin-fixed end of the hollow fiber membrane, to form a hollow fiber membrane bundle group;

distributing space between the divided hollow fiber membrane bundles by fixing the ends of the hollow fiber membrane bundle group with resin and cutting the fixed ends;

forming regularly distributed axial channels; and

forming a plurality of regularly distributed ports C on one of the fixed ends and forming a hollow fiber membrane open end on the other end.

(8) The method for manufacturing a hollow fiber membrane module, recited in (7), wherein the arrangement of the hollow fiber membrane bundles is in the form of a spiral in the cross-section direction of the hollow fiber membrane bundle group.

(9) The method for manufacturing a hollow fiber membrane module, recited in (7), wherein the plurality of ports C, communicating with the outer surface of the hollow fiber membrane established on the resin-fixed end of the hollow fiber membrane, is arranged in a spiral.

[0014]

With the structure as in (1), patches do not occur in the radial flow in the module, the axial liquid flow becomes a nearly uniformly distributed flow, and the uniformly distributed flow in the feed portion (port B or port C) can be sustained up to the concentrate discharge port (port C or port B).

[0015]

The hollow fiber membrane in the present invention is a hollow fiber separation membrane and no particular limits apply to the membrane material, membrane structure, and membrane dimensions. For example, [the membrane] may be an asymmetric membrane of cellulose acetate or polyamide, or a composite membrane of polyamide or polysulfone.

[0016]

The filling rate of the hollow fiber membrane bundles in the present invention is defined with the following formula. The filling rate is 40 to 80%, and preferably 50 to 65%.

Filling rate (%) = (hollow fiber membrane outer diameter^2 $\times\pi/4$ $\times$ number of hollow fiber membranes) / area of the narrowest cross section perpendicular to the axis of the container)$\times$100

[0017]

The resin in the present invention is not limited so long is it can form a fluid-tight seal for the hollow fiber membrane. For example, thermosetting resins such as polyurethane resin, epoxy resin, silicon[e] resin, or the like can be used; thermoplastic resins can also be used as necessary.

[0018]

The hollow fiber membrane bundle in the present invention may comprise a plurality of hollow fiber membranes bundled in the same direction, preferably comprises a bundle of several tens to several hundreds of hollow fiber membranes, and more preferably comprises a bundle of 50 to 200 hollow fiber membranes.

[0019]

The hollow fiber membrane bundle group in the present invention is a structured body comprising a port partition member for collecting a plurality of hollow fiber membrane bundles and dividing the channel, and a port dispersing member for making a plurality of divisions in the port C,

which communicates with the outer surface of the hollow fiber membrane disposed on the resin-fixed end of the hollow fiber membrane. In the cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundle group, the arrangement of the hollow fiber membrane bundles is not particularly restricted, but is preferably a regular arrangement, and more preferably a concentric circle, spiral, or honeycomb core arrangement. Also, there is preferably a space communicating as far as the center portion in a cross-sectional direction perpendicular to the axis of the hollow fiber membrane bundle group, in the vicinity of at least one port B communicating with the outer surface of the hollow fiber membrane established on the side of the container.

[0020]

The partition member in the present invention forms regular intervals in the hollow fiber membrane bundle and is not particularly restricted if it has a structure which divides the channel. For example, it is possible to use a partition sheet member 7, 12, shown in Figure 4, comprising a wavy sheet and flat sheet bonded and heat-fused [together]. The constituent material is not particularly restricted if it is a material which adheres to the resin used in module bonding such as urethane resin, epoxy resin, or the like, has no elution, does not damage the hollow fiber membrane, and is not easily soiled by foulant; examples include polyethylene, polypropylene, polyvinyl chloride, polyester, polysulfone, polyether sulfone, fluororesin, and the like.

[0021]

The spiral arrangement in the present invention, noted in (5), (6), (8), and (9), is not particularly restricted if it comprises an arrangement with the hollow fiber membrane bundles spiraling out from the center of the axial cross-section of the container; [the arrangement] preferably is expressed in polar coordinates (r, θ) on the axial cross-section of the container with the origin being the center of the axial cross-section of the container, where the path on the arrangement of the axial cross-section of the hollow fiber membrane bundles and the path on the arrangement of the axial cross-section of the port C are $r=a\theta^{K}\pm\beta$ (constants α, β, and k are real numbers), and more preferably is a parabolic spiral arrangement where k=1/2.

[0022]

Described in (2) in the present invention, the port C, communicating with the outer surface of the hollow fiber membrane established on the resin end which fixes the closed end of the hollow fiber membrane, is a raw water feed port for the module or a concentrating port for concentrate drainage; [the present invention] comprises at least one [port]. Preferably a plurality of ports

comprise a regular, equivalent arrangement. More preferably, [the arrangement is] a concentric circle, spiral, or honeycomb core arrangement.

[0023]

The length of the hollow fiber membrane which is not bonded and fixed in the hollow fiber membrane bundles in the present invention is at least 1.01 times, and preferably at least 1.05 times, the length of the distance between both bonded parts; the structure is such that the hollow fiber membrane can oscillate within the container. The hollow fiber membrane can thereby oscillate during water purification treatment and the adhesion and accumulation of foulant on the surface of the hollow fiber membrane and in the gaps in the hollow fiber membrane can be suppressed.

[0024]

[Modes of Embodiment of the Invention]

The details of and manufacturing method for a hollow fiber membrane module, based on an embodiment of the present invention in the drawings, are described below. Figure 1 shows a hollow fiber membrane module in the present invention, Figure 2 shows a cross-sectional view of the vicinity of the feed port, and Figure 3 shows a cross-sectional view of the concentrating port at the bonded end.

[0025]

As shown in Figure 1, the hollow fiber membrane module in the present invention comprises a container 1 having a feed port 51 through which feed water enters, a hollow fiber membrane bundle group 13 installed in the container 1, and a cap 2, 3 for discharging treated permeate and concentrate. As shown in Figure 4, the hollow fiber membrane bundle group 13 comprises hollow fiber membrane bundles 4 installed with [sic] a partition member 7 and port dispersing member 12 and bundled [together]. The hollow fiber membrane bundle group in the vicinity of port 51 comprises a space 8 communicating between the central part and outside of the cross-section perpendicular to the axis of the hollow fiber membrane bundle group, and a partition member 7 forming a plurality of divisions in the channel in the direction of the cross-section perpendicular to the axis of the hollow fiber membrane bundle group. The distributed channel 9, with a plurality of divisions, is distributed regularly as shown in Figure 2. The hollow fiber membrane bundle 4 is installed such that the length of the hollow fiber membrane which is not bonded and fixed is at least 1.05 times the length of the distance between the bonded parts of both ends, and has a structure such that it can oscillate within the container 1. The permeate flows out via the permeate port 53 of the

hollow fiber membrane part fixed with resin 5 and having an opening; the concentrate is discharged via the concentrate port 52, with a plurality of divisions and ends sealed with resin 6. Figure 3 shows a cross-sectional view of the distributed concentrate port 52 area.

[0026]

An example of the method for manufacturing the hollow fiber membrane module in the present invention is described below. The hollow fiber membrane module has the hollow fiber membrane bundles arranged in valleys of the partition member 7 and port dispersing member 12; the aggregate of the hollow fiber membrane bundles which has a sheet-like form is rolled to form the hollow fiber membrane bundle group 13. At this time, because the port dispersing member 12 forms the inlet area of the concentration port in the resin-fixed end, the manufacturing process can be simplified by sealing part of the space, separated by the wavy sheet and flat sheet, with resin in advance. The resin at this time is not particularly restricted if it is the same as the resin fixing the ends of the hollow fiber membrane. The rolled hollow fiber membrane bundle aggregate 13 is inserted in the container 1, the molds 14, 15 are installed on both ends, and both ends of the hollow fiber membrane bundle group are permeated with resin using the centrifugal adhesion method, pot bonding method, or the like, and bonded and fixed. The port dispersing member 12 is also permeated with resin, bonded and fixed at the same time. After the resin is cured, the molds are removed and surplus parts are cut off. At this time, a partitioned space, divided by the wavy sheet and flat sheet of the port dispersing member 12 in the resin end on the closed end side of the hollow fiber membranes, forms a plurality of through holes in the resin end.

[0027]

A hollow fiber membrane module, which can have a uniformly distributed flow in all the fluid channels from the raw water feed to the concentrate outlet, is attained with the manufacturing process described above.

[0028]

[Embodiments]

The present invention is described below concretely using the embodiments, but the present invention is not restricted thereby.

[0029] Embodiment 1

A hollow fiber membrane bundle was formed by bundling 150 polyamide nano-filtration hollow fiber membranes (hollow fiber membrane outer diameter 300 μm, hollow fiber membrane

inner diameter 200 μm); 32 hollow fiber bundles (4800 hollow fibers in total) were arranged on a vinyl chloride partition member (axial length 15 mm) and a port dispersing member with the end sealed with resin; [this] was rolled to prepare a hollow fiber membrane bundle group. This hollow fiber membrane bundle group was inserted in a cylindrical polycarbonate container in such a manner that the length of the hollow fiber membrane not bonded and fixed in hollow fiber membrane bundles became 1.05 times the distance between both bonded ends. The filling rate was 53%; both ends were centrifugally bonded with epoxy resin and surplus parts were cut off to prepare a hollow fiber membrane module. Using this module and a calcium chloride aqueous solution with a concentration of 500 ppm, the linear velocity dependency of the extraction ratio of calcium chloride was measured under the following conditions: feed pressure 3 kg/cm^2, temperature 25 degrees Celsius, and pH 6. As shown in Figure 6, the extraction ratio in the low linear velocity range (at 2 m/min) was 0.9. At a linear velocity of 2.5 m/min or greater, the extraction ratio was nearly constant.
Extraction ratio = (extraction ratio in the module) / (extraction ratio of the hollow fiber membrane)
Linear velocity = (feed water flow rate + concentrate flow rate) /2/ (cross-sectional area of the space perpendicular to the axis of the container)

[0030]

Using the hollow fiber membrane module 1 in Embodiment 1, continuous operation was performed at a rate of recovery of 80% at tap water pressure (2.0 to 2.3 kg/cm^2), with Otsu city tap water passed through an activated carbon filter (Advantec, TCC-W1SOCO). During the period of continuous operation, cleaning was not performed and operation was performed at a constant rate of recovery. The transmission rate during continuous operation varied as shown in Figure 7; the transmission rate ratio after 48 hours and after one month was 0.95; and the drop in transmission rate was very slight.
Transmission rate ratio = (transmission rate after one month) / (transmission rate after 48 hours)

[0031] Reference example 1

Using the same hollow fiber membrane and cylindrical container as in Embodiment 1, 6900 hollow fiber membranes were bundled together; and with a filling rate of 77%, a hollow fiber membrane module was prepared without the use of the partition member and the port dispersing member. Using this module and a calcium chloride aqueous solution with a concentration of 500 ppm, the linear velocity dependency of the extraction ratio of calcium chloride was measured under

the following conditions: feed pressure 3 kg/cm^2, temperature 25 degrees Celsius, and pH 6. As shown in Figure 6, the extraction rate in the low linear velocity region (at 2 m/min) was 0.7.

[0032]

Using the hollow fiber membrane module 1 in Reference example 1, continuous operation was performed at a rate of recovery of 80% at tap water pressure (2.0 to 2.3 kg/cm^2), with Otsu city tap water passed through an activated carbon filter (Advantec, TCC-W1SOCO). During the period of continuous operation, cleaning was not performed and operation was performed at a constant rate of recovery. The transmission rate during continuous operation varied as shown in Figure 7, the transmission rate ratio after 48 hours and after one month was 0.65; the transmission rate dropped greatly.

[0033]

Reference example 2

Using the same hollow fiber membrane and cylindrical container as in Embodiment 1, 4750 hollow fiber membranes were bundled together; and with a filling rate of 53%, a hollow fiber membrane module was prepared without the use of the partition member and the port dispersing member. Using this module and a calcium chloride aqueous solution with a concentration of 500 ppm, the linear velocity dependency of the extraction ratio of calcium chloride was measured under the following conditions: feed pressure 3 kg/cm^2, temperature 25 degrees Celsius, and pH 6. As shown in Figure 6, the extraction ratio in the low linear velocity region (at 2 m/min) was 0.3.

[0034]

Table 1 shows a listing of the results from Embodiment 1 and Reference examples 1 and 2.

[0035]

[Table 1]

	Extraction rate ratio at a 2 m/min linear velocity	Transmission ratio during continuous operation at a tap water rate of recovery of 80%
Embodiment 1	0.9	0.96
Reference example 1	0.7	0.65
Reference example 2	0.3	—

[0036]

[Effects of the Invention]

In water purification of natural water such as river water or ground water, or advanced water purification of tap water, and particularly in the field of water purification where long-term continuous operation at a high rate of recovery is required, the hollow fiber membrane module in the present invention generates a uniformly distributed flow from the feed to the concentrate discharge outlet without causing channeling even in the case of operation at a low linear velocity within the module, allows the recovery of membrane performance through physical cleaning or the like, can efficiently use the membrane and raise the separation efficiency, and can make possible continuous stable operation while suppressing the adhesion and settling of foulant and without markedly reducing the transmission rate. Also, during cleaning, [the present invention] creates a uniformly distributed flow in the cross-section perpendicular to the axis of the hollow fiber membrane bundles, which are the cleaning medium, and can easily discharge foulant removed by the cleaning effects.

[Brief Description of the Drawings]

[Figure 1] is a conceptual drawing showing an example of the hollow fiber membrane module relating to the present invention.

[Figure 2] is a cross-sectional view at line A-A' showing an example of the feed water partition area in the vicinity of the feed port.

[Figure 3] is a cross-sectional view at line B-B' of the resin-fixed portion having a port with multiple divisions.

[Figure 4] is a descriptive diagram of the hollow fiber membrane bundle group and the method of manufacture thereof.

[Figure 5] is a conceptual drawing showing an example of the hollow fiber membrane bundle group installed in a container or mold.

[Figure 6] is a graph of the linear velocity dependency of the extraction ratio.

[Figure 7] shows the results of continuous operation at an 80% rate of recovery of tap water.

[Explanation of the Reference Numerals]

1 Container

4 Hollow fiber membrane bundle

5, 6 Resin fixation

7 Partition member

8	Communicating space
9	Distributed channel
11	Resin sealed portion
12	Port dispersing member
13	Hollow fiber membrane bundle group
14, 15	Mold
51	Feed port (port B)
52	Concentrate port (port C)
53	Transmission port (port A)

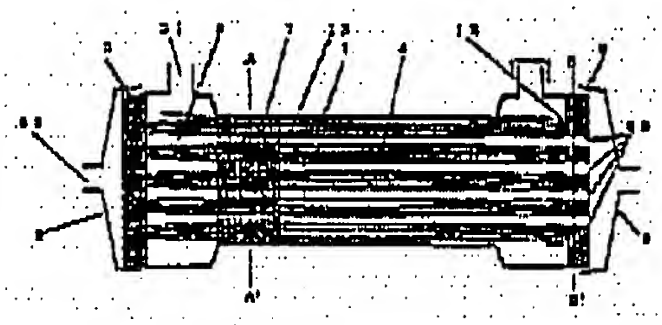


Figure 1

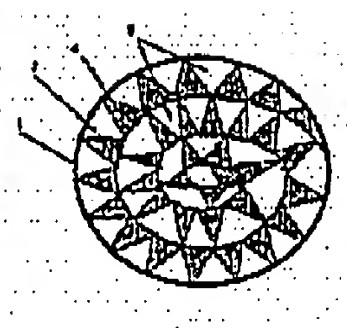


Figure 2

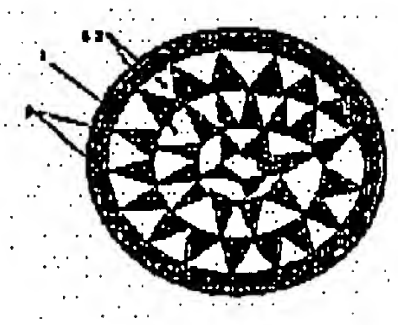


Figure 3

Figure 4

Figure 5

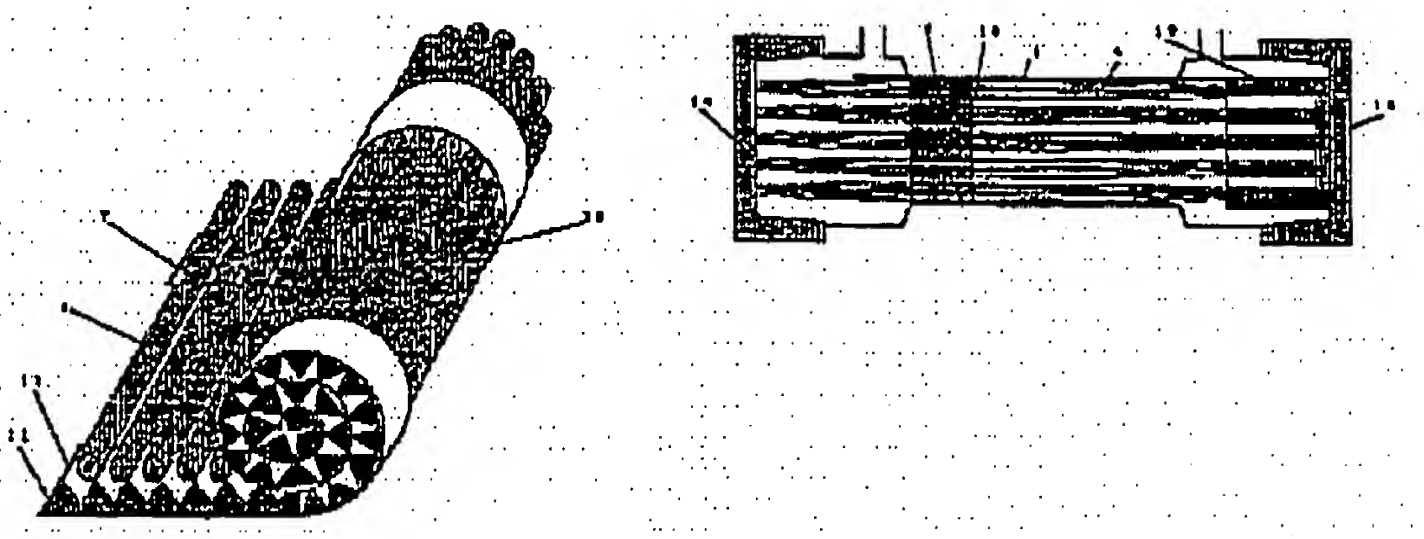
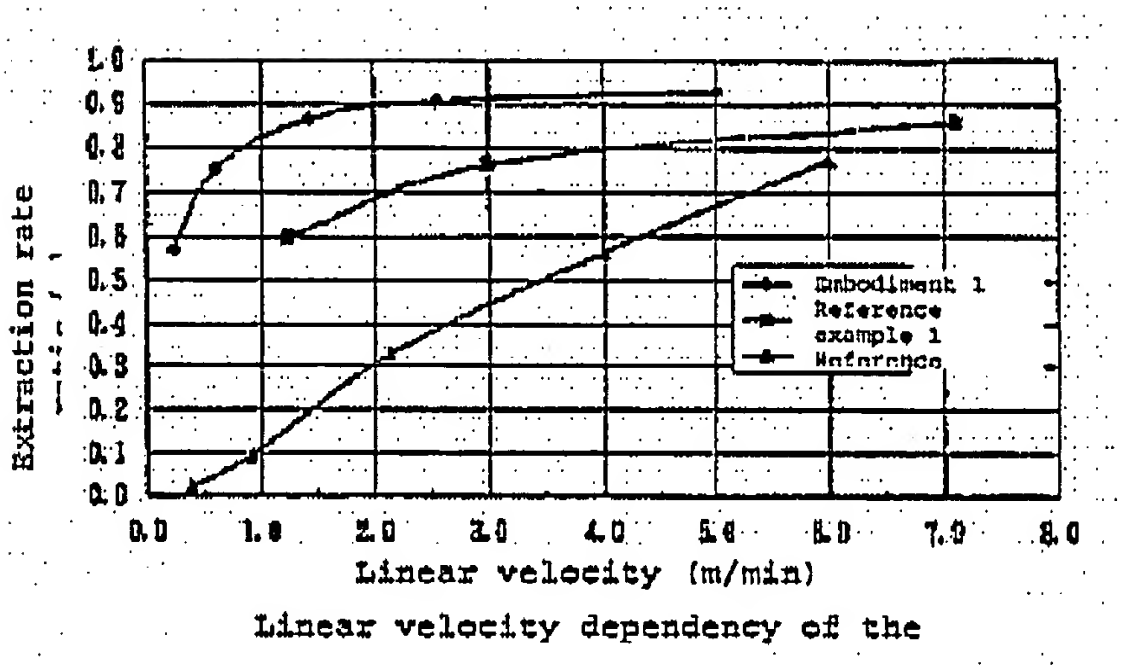
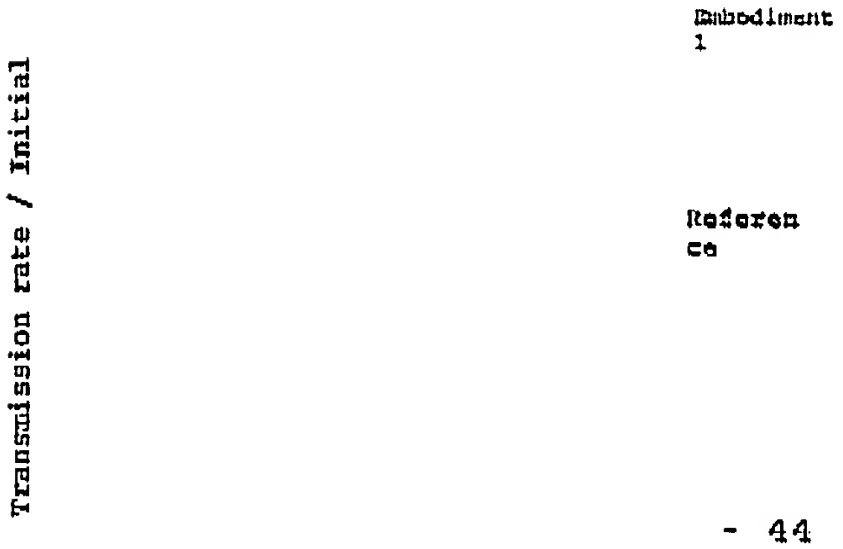


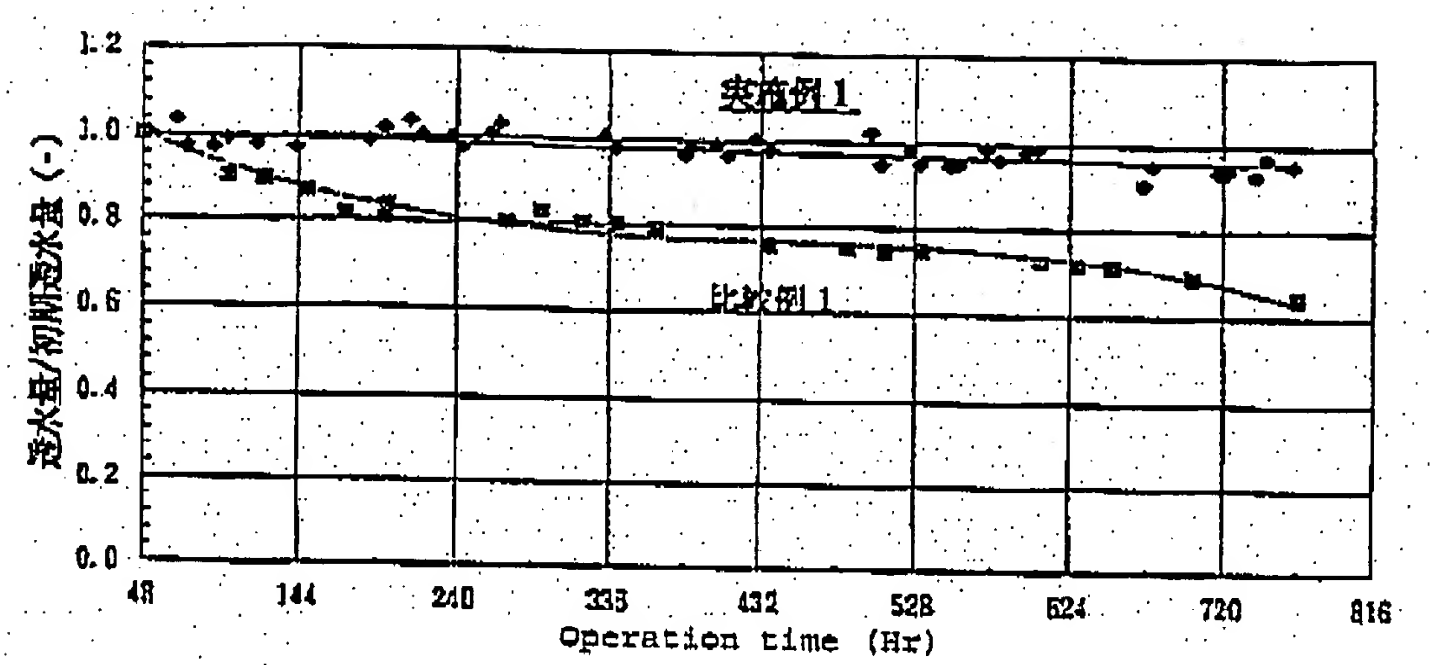
Figure 6



Linear velocity dependency of the

Figure 7





Continuous operation at a tap water

EXHIBIT A

Attorney Docket No. 2000.16 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Runkle, et al

Art Unit: 1732

Serial No. 09/851,242

Examiner: S. Staicovici

Filed: May 8, 2001

For: HOLLOW FIBER MEMBRANE CONTACTOR
AND METHOD FOR MAKING SAME

DECLARATION UNDER RULE 132

I, Charles J. Runkle, declare:

1. I am a named inventor in the above captioned application.

2. I am also a named inventor in U.S. Patent Numbers 5,186,832 (Mancusi et al) and 5,284,584 (Huang et al) cited against the above captioned application.

3. In the instant application, Paper No. 6, page 4, paragraph 9, and page 6, paragraph 12, the Examiner states:

> "..., it should be noted that Mancusi et al ('832) specifically teach potting of the tube-sheets to the interior of the housing (see col. 9, lines 22-27)."

4. The Examiner's interpretation of that portion of Mancusi et al is incorrect.

5. The portion of Mancusi et al cited by the Examiner states:

> "After the bundle is installed in the housing, the tube sheet(s) is (are) sealed to the interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane."

6. That portion does not refer to "potting the structure and the shell together."

7. That portion refers to the use of o-rings to form a seal.

8. The portion of Mancusi et al cited by the Examiner and set out in Paragraph 5 above appears in Huang et al at column 9, lines 11-16.

9. Therein, it is stated that the "bundle" is "sealed" to the "housing."

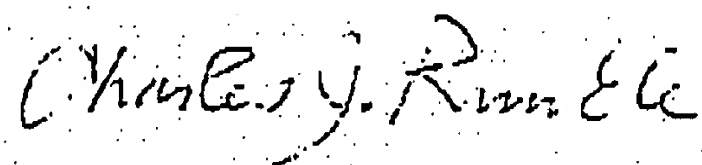
10. In that passage, "sealed" refers to the use of o-rings.

11. At Huang et al, column 21, lines 58-61 and Figure 6, it is shown that "sealing" refers to o-rings.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made

with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,



Charles J. Runkle

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EXAMINER	
STAICOVICI, STEFAN	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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US PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte CHARLES J. RUNKLE,
AMITAVA SENGUPTA, and TONY R. VIDO

Appeal No. 2004-2240
Application No. 09/851,242

1000.16

ON BRIEF

Before PAK, KRATZ, and PAWLIKOWSKI, Administrative Patent Judges.

KRATZ, Administrative Patent Judge.

REMAND TO THE EXAMINER

Upon a careful review of the record in this appeal, we determine that this application is not in condition for a decision at this time. Accordingly, pursuant to our authority under 37 CFR § 41.50(a)(1)(effective Sept. 13, 2004; 69 Fed. Reg. 49960 (Aug. 12, 2004); 1286 Off. Gaz. Pat. Office 21 (Sept. 7, 2004)), we remand this application to the jurisdiction of the examiner for action consistent with our remarks below.

Appellants' invention relates to a method for making a hollow fiber membrane contactor wherein a hollow fiber fabric is wound around a center tube and the tube and fabric are potted

together to form a unitized structure. Thereafter, the unitized structure is placed in a shell and the structure and shell are mold-potted together via the injection of a potting material into a space between the structure and shell. A further understanding of the invention can be derived from a reading of exemplary claims 1 and 21, reproduced in an Appendix to appellants' brief.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Bikson et al. (Bikson)	4,800,019	Jan. 24, 1989
Caskey et al. (Caskey)	4,961,760	Oct. 09, 1990
Mancusi et al. (Mancusi)	5,186,832	Feb. 16, 1993
Huang et al. (Huang)	5,284,584	Feb. 08, 1994

Claims 1, 2, 4, 5, 19 and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mancusi in view of Bikson. Claims 16-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mancusi in view of Bikson and Caskey. Claims 1, 2, 4, 5, 16 and 18-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Huang in view of Mancusi and Bikson. Claim 17 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Huang in view of Mancusi, Bikson and Caskey. Claims 21-23, 27 and 28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mancusi in view of Bikson and alleged admitted prior art. Claims 24-26 stand rejected under 35 U.S.C.

§ 103(a) as being unpatentable over Mancusi in view of Bikson, Caskey and alleged admitted prior art. Claims 21-24 and 26-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Huang in view of Mancusi, Bikson and alleged admitted prior art. Claim 25 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Huang in view of Mancusi, Bikson, Caskey and alleged admitted prior art.

Two pivotal issues relative to all of the rejections advanced by the examiner that have been raised on this appeal are: (1) whether or not Mancusi reasonably discloses or suggests the use of two potting steps; and, (2) whether or not Mancusi together with Bikson teach or suggest a second potting step involving a mold-potting of the shell and unitized structure (previously potted fabric and tube structure) as an obvious option to one of ordinary skill in the art.

However, in applying Mancusi to the claimed subject matter, the examiner appears to have confusingly referred to portions of several separate options for forming a cartridge disclosed in the patent without fully explaining how each of those separate embodiments of Mancusi considered alone, or in combination with Bikson, teach or suggest the claimed process including two potting steps reasonably corresponding to appellants' claimed

potting steps. For example, we note that Mancusi (column 9, lines 53-55) draws a distinction between cartridges that are cast-in-place into a module and those that are inserted into a pressure housing.[1]

Concerning the fabrication of cast-in-place modules, Mancusi (column 9, line 63 through column 10, line 26) teaches that a bundle (as prepared above) is inserted into a cast-in-place housing and the bundle ends are sealed with a potting cup clamped over the housing ends. The examiner should determine whether or not that sealing step in forming the cast-in-place module corresponds to or would have suggested the claimed mold-potting step to one of ordinary skill in the art. Then, the examiner should further determine whether or not the bundle employed in making that cast-in-place module of Mancusi would have been

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[1] In contrast to forming cast-in-place modules, Mancusi (column 10, lines 41-60) teaches that relatively large cartridges should be potted by forming end seals for the bundle ends concurrently with a winding step without employing a subsequent potting step. For that embodiment, the examiner should further explain (to the extent the examiner maintains the rejection after remand based on that embodiment) how Mancusi in combination with Bikson's teachings respecting the use of molds in potting and sealing bundle ends prior to installing the hollow fiber bundle into an enclosure would have reasonably suggested to one of ordinary skill in the art using a second mold-potting step, as appellants' claim, for potting the structure and shell together. See column 4, line 48 through column 9, line 36 of Bikson.

understood by one of ordinary skill in the art as including a potted bundle that was formed by winding a hollow fiber fabric around a tube and subsequent potting thereof as described above in Mancusi (column 8, line 44 through column 9, line 4). If so, the examiner should explain how that cast-in-place manufacturing method corresponds to appellants' claimed method (see at least claim 1) on a claim-by-claim basis to the extent the claims are separately argued.

In addition, we note that notwithstanding appellants' numerous remarks and reliance on a declaration of Charles J. Runkle in both the brief (pages 21 and 22, and Exhibit A), and the reply Brief (pages 10, 18 and 19), the examiner has failed to mention that declaration or particularly address appellants' remarks concerning that declaration in the answer.

Secondary considerations of obviousness, such as the Runkle declaration, when entered into the record, must be considered by the examiner. See Richardson-Vicks Inc. v. Upjohn Co., 122 F.3d 1476, 1483, 44 USPQ2d 1181, 1186 (Fed. Cir. 1997); see also Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1538, 218 USPQ 871, 879 (Fed. Cir. 1983). However, on this record, the examiner has not specifically addressed in the answer to appellants' declaration (mentioned both in the brief and the reply brief as

noted above; see the answer in its entirety). The answer should reflect that appellants' arguments and any entered evidence relied upon were weighed against the examiner's evidence of obviousness. See In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992); In re Piasecki, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984); and In re Rinehart, 531 F.2d 1048, 1052, 189 USPQ 143, 147 (CCPA 1976).

Accordingly, we remand this application to the jurisdiction of the examiner for a thorough and careful consideration of the matters discussed above in a Supplemental Examiner's Answer should any of the rejections be maintained.

Pursuant to the provisions of 37 CFR § 41.50(a)(2)(effective Sept. 13, 2004; 69 Fed. Reg. 49960 (Aug. 12, 2004); 1286 Off. Gaz. Pat. Office 21 (Sept. 7, 2004)), appellants are required to timely respond to any supplemental examiner's answer issued in response to this remand. As stated in this rule, appellants must exercise one of the two following two options to avoid sua sponte dismissal of the appeal as to the claims involved in the remand: (I) request that prosecution be reopened before the examiner by filing a reply under Rule 111 with or without amendment or evidence or (II) request that the appeal be maintained by filing a reply brief as provided in § 41.41.

This application, by virtue of its "special" status, requires an immediate action; see MPEP § 708.01 (D)(8th ed., Rev. 2, May 2004, p. 700-126). It is important that the Board of Patent Appeals and Interferences be promptly informed of any action affecting the appeal in this application.

REMANDED

CHUNG F. PAK
Administrative Patent Judge)

PETER F. KRATZ
Administrative Patent Judge) BOARD OF PATENT APPEALS AND INTERFERENCES

BEVERLY A. PAWLIKOWSKI
Administrative Patent Judge)

PFK/sld

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X Related Proceeding Appendix

Date	Proceeding
January 7, 2005	Appeal No. 2004-2240, Application No. 09/851,242, On Appeal case Remanded to Examiner
March 29, 2005	Supplemental Examiner's Answer, Paper No. 03/08/2005
May 18, 2005	Reply Brief to Examiner's Supplemental Answer under § 41.41
May 26, 2005	Applicant's File a Supplemental IDS, Pursuant to Rules 56 & 97
July 28, 2005	The Examiner reopens prosecution based on the Supplemental IDS, makes action final.
September 28, 2005	Applicant files a request for reinstatement of the appeal with a supplemental Appeal Brief in Accordance with 37 CFR 41.31.
December 13, 2005	Notification of Non-Compliant Appeal Brief (37 CFR 41.37)
January 4, 2006	Applicant re-files a request for Reinstatement of the Appeal with an Amended Supplemental Appeal Brief in Accordance with 37 CFR 41.31.